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Extreme Temperature/Radiation Tolerant Crystal Oscillator for High Reliability Space Applications

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***Abstract*—**Chronos Technology (Div. of FMI, Inc.) is presently involved in an SBIR phase II effort to produce and deliver a comprehensive, practical and commercially available solution for a novel extreme temperature (both cold & hot), and radiation tolerant, compact radio frequency clock source (RTXO). Offering compelling features such as surface mounting, scalable configuration and miniature footprint, this innovative technology directly targets a wide range of requirements.

RTXO satisfies the critical requirements of NASA space programs such as Mars Science Laboratory (MSL), MER and future missions to Moon at both system and subsystem level with operating temperatures in the -180˚C to +120˚C.

It also addresses the requirements of the extreme high temperature RTXO that could be utilized for the missions to Venus and other extreme environment space systems with highest operating temperature range to 460˚C and high ambient pressure to 90 Bar.

Furthermore, the RTXO enables and improves wide range of scientific, military & commercial space systems with its miniaturized footprint and rugged construction.

As for non space systems, it delivers a higher level of performance at smaller size to critical down-hole, nuclear process monitoring and very demanding geothermal applications.

Chronos Technology is the R&D division of Frequency Management International Inc. (FMI), a U.S. based, owned and operated company that offers high reliability frequency control products such as crystal resonators, crystal oscillators, VCXOs, and phase locked sources for applications ranging from high temperature down-hole and geothermal systems to commercial and scientific space. In addition to the scalable design, the proposed solution includes the electromechanical assembly and manufacturing processes to facilitate reliable and repeatable RTXO manufacturing. We have already fabricated and tested resonators for the extreme low temperature applications and completed the circuit design of the extreme low temperature RTXO using the thermal compliant and radiation tolerant elements.

We have already established the scalable designs for a wide range of crystal resonator frequencies in the single rotation miniature configuration for the extreme low temperature RTXO. The scope of progress so far offers a clear path to fabricating RTXO for extreme low and high temperature ranges.

We do expect that our solution will immediately and profoundly impact plans for the present and future space missions and for standard and other extreme environment space applications. RTXO brings new paradigm to resolve space systems design risk in terms of higher reliability and performance at significantly reduced size, weight and manufacturing time which all point to lower cost. This effort will yield innovations ranging from unique extreme temperature and high-Q resonator material, a unique matching integrated resonator driver amplifier/buffer based on Silicon Carbide (SiC) and the smallest surface mount high reliability, space level, radiation tolerant clock source.